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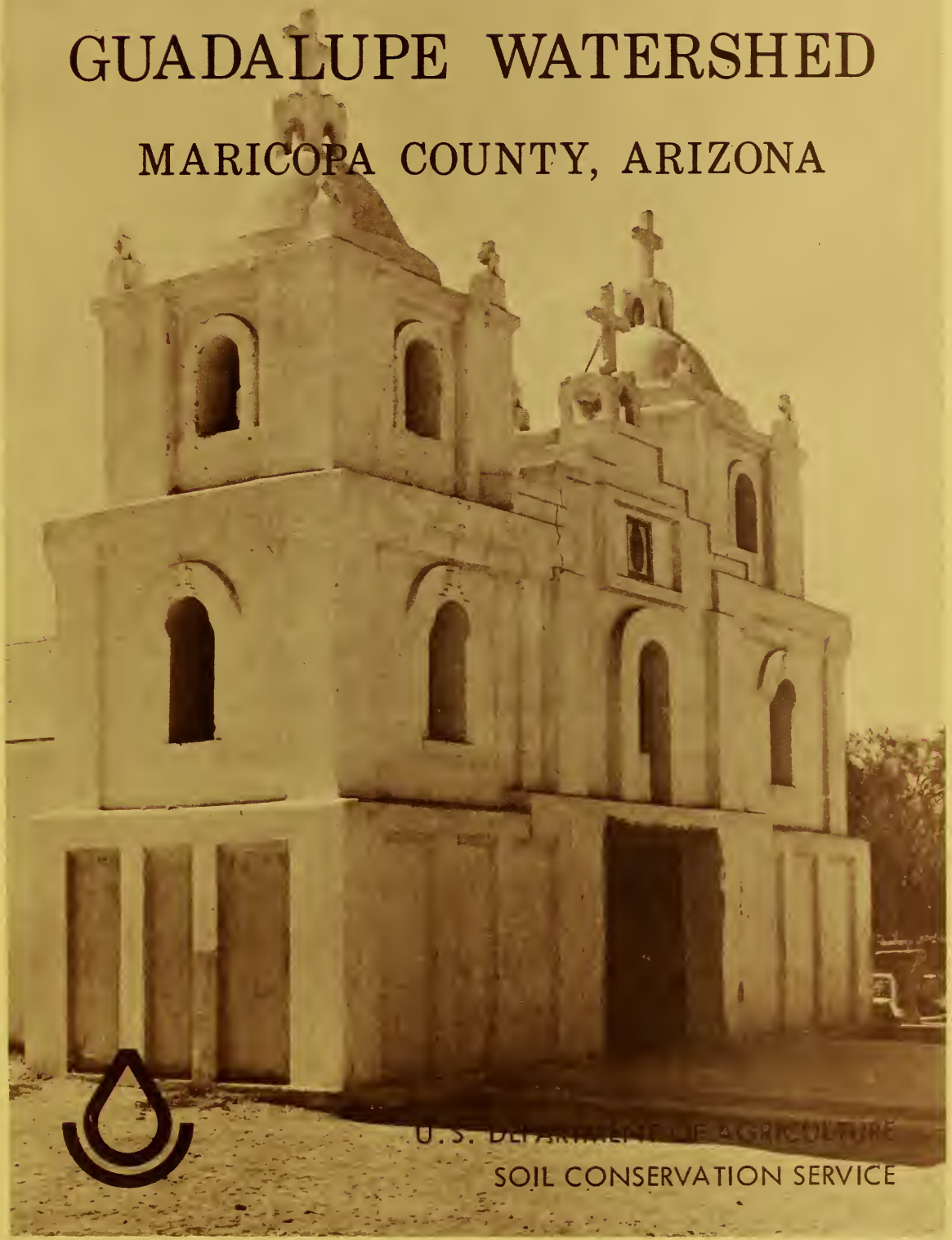
WATERSHED WORK PLAN

GUADALUPE WATERSHED

MARICOPA COUNTY, ARIZONA



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Prepared under the authority of the Watershed Protection & Flood Prevention Act
(Public Law 566, 83rd. Congress, 68 Stat. 666) as amended.

JANUARY 1971

USDA-SCS-PORTLAND, OREG. 1971

ADDENDUM

GUADALUPE WATERSHED WORK PLAN, ARIZONA

This addendum shows the results of using an interest rate of 5-3/8 percent in the economic evaluation. Annual project costs, benefits, and benefit cost ratio are as follows:

1. Project costs are $39,170

2. Project benefits are $121,100

3. The project benefit cost ratio is 3.1 to 1.0

September 8, 1971

Watershed Work Plan
Guadalupe Watershed

Maricopa County, Arizona

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Flood Control District of Maricopa County

East Maricopa Soil Conservation District

With Assistance by:

U.S. Department of Agriculture, Soil Conservation Service

January 1971

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Guadalupe Watershed, Arizona

WATERSHED WORK PLAN AGREEMENT

between the

Flood Control District of Maricopa County
East Maricopa Soil Conservation District
(hereinafter referred to as the Sponsoring Local Organization)

State of Arizona

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Guadalupe Watershed, State of Arizona, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666) as amended;

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Guadalupe Watershed, State of Arizona, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about two years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the federal government such land rights as will be needed in connection with the works of improvement. (Estimated cost $339,430.)

2. The Sponsoring Local Organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

   The Service will bear 100 percent of the first $25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of $25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	52.5	47.5	0 1/

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The total construction cost of the structural measures will be borne by the Service. (Estimated cost $246,360.)

5. The total engineering cost will be borne by the Service. (Estimated cost $55,360.)

6. The Sponsoring Local Organization and the Service will each bear the cost of Project Administration which it incurs, estimated to be $4,380 and $27,690 respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either pary initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.

Flood Control District of Maricopa County

By X Henry A. Davis

Title Chairman

Address Maricopa County

Date August 16, 1971

The signing of this agreement was authorized by a motion of the governing body of the Flood Control District of Maricopa County adopted at a meeting held on August 16, 1971

Clerk Rhea Woodall

Date August 16, 1971

East Maricopa Soil Conservation District

By Walter D. White

Title Chairman, EMSCD

Address 3939 E. Hermosa Vista Dr.
Mesa, Arizona 85205

Date July 30, 1971

The signing of this agreement was authorized by a resolution of the governing body of the East Maricopa Soil Conservation District adopted at a meeting held on July 30, 1971

Secretary James A. Smith

Date July 30, 1971

Soil Conservation Service
UNITED STATES DEPARTMENT OF AGRICULTURE

By Marion E. Strong
(State Conservationist)

Date Sept. 14, 1971

Watershed Work Plan
Guadalupe Watershed

Maricopa County, Arizona

January 1971

SUMMARY OF WORK PLAN

Size and Location

Guadalupe Watershed is located southeast of the City of Phoenix. The economically depressed community of Guadalupe is within the watershed. The watershed has a drainage area of 4,590 acres.

Sponsoring Local Organizations

This work plan was prepared by the Flood Control District of Maricopa County and the East Maricopa Soil Conservation District. The Guadalupe Organization, Incorporated, though not a sponsor, contributed significantly to the preparation of this work plan. Technical assistance was furnished by the Soil Conservation Service of the United States Department of Agriculture. The Arizona Highway Department and Our Lady of Guadalupe Catholic Church are endorsees.

Watershed Problems

Serious floods cause damage to residences, business establishments, churches in Guadalupe, county roads and streets. Floods also inundate growing crops, damage irrigation canals, interrupt irrigation deliveries and damage other agricultural facilities.

Another problem caused by floodwater is that of health and sanitation. The floodwater flows through outdoor toilets, fills cesspools and inundates yards and homes. Runoff after passing through Guadalupe ponds against the banks of the Highline Canal to a depth of a foot or more before overtopping the canal. This ponded water stagnates quickly and persists as a stagnant pool creating unsanitary conditions, and constituting an attraction for, but a health hazard to small children.

The floodwater causes erosion to the streets in Guadalupe, county roads and highways, and deposits sediment and trash over the project area.

Works of Improvement to be Installed

Works of improvement proposed in this plan include land treatment measures for environmental purposes and the construction of structural works needed to reduce the floodwater and sediment damages to the floodplain area.

The East Maricopa Soil Conservation District will continue to assist in the follow-up and maintenance of the installed land treatment measures on farms. The Flood Control District of Maricopa County will install the environmental land treatment measures.

The City of Phoenix will continue its existing conservation program of maintaining South Mountain Park in its natural desert setting consistent with recreation purposes.

One floodwater retarding structure, a buried outlet pipeline and a diversion will be installed to protect the community of Guadalupe, southwest Tempe and the cultivated area to reduce floodwater and sediment damages.

A two year installation period is planned for this project. The total project cost of $693,700 will be borne by P.L. 566 and other funds as shown below:

Item	Project Costs (Dollars)		
	P.L. 566 Funds	Other Funds	Total
Land Treatment Measures		20,480 1/	20,480
Structural Measures - Flood Prevention	329,410	343,810	673,220
TOTAL	329,410	364,290	693,700

1/ Includes technical assistance of $480.

BENEFITS AND COSTS

The total average annual benefits resulting from installation of structural measures are estimated at $121,100.

The average annual cost of the proposed structural measures is estimated at $35,880. The ratio of average annual benefits to average annual costs is 3.4:1.0.

INSTALLATION, OPERATION, AND MAINTENANCE

Land treatment measures on private lands will be maintained by farmers cooperating with the East Maricopa Soil Conservation District. The Flood Control District of Maricopa County will maintain the environmental land treatment measures.

The Flood Control District of Maricopa County will construct, operate, and maintain the structural works of improvement for flood prevention.

Operation and maintenance agreements will be executed between the responsible agencies and the Soil Conservation Service prior to issuing invitation to bid. Total average annual operation and maintenance costs attributed to structural measures are estimated at $1,140.

Plan de Trabajo de Division de Agua

Divisiones de Agua de Guadalupe

Condado de Maricopa, Arizona

enero 1971

RESUMEN DEL PLAN

Tamaño Y Localidad

La División de Agua de Guadalupe está localizada al sudeste de Phoenix. La comunidad de Guadalupe, economicamente deprivada, está dentro de dicha división de aguas que tiene un area de drenaje de 4,590 acres.

Organizaciones Locales Patrocinantes

Este plan de trabajo fué preparado por la Oficina de Control de Inundaciones del Condado de Maricopa y el Distrito del Este de Maricopa de Conservacion de Terrenos. La Organizacion de Guadalupe, aunque no es patrocinante, contribuyó significativemente en la preparación de este plan de trabajo. Asistencia técnica fué proveida por la Oficina de Conservacion de Tierras del Departamento de Agricultura de los Estados Unidos. El Departmanto de Carreteras de Arizona y la iglesia Católica de Nuestra Sra. de Guadalupe, apollan el plan.

Problemas de la División de Aguas

Inundaciones serias causan daños a las residencias, establecimientos comerciales, iglesias en Guadalupe, calles y carreteras del Condado. Las inundaciones también dañan cosechas, canales de irrigacion, interrumpen la entrega de agua de irrigation y dañan otras facilidades agrícolas.

Otro problema causado por las inundaciones son las de salud y sanidad. Las aguas pasan por entre los escusados de afuera, se llenan los posos de letrina y luego inundan yardas y casas. El agua que queda después de pasar por Guadalupe se encharca contra las orillas del Canal Highline a una altura de más de un pie antes de entrar al canal. Esta agua estancada cría condiciones no-sanitarias, constituyendo una atracción a los niños pegueños pero peligrosa a su salad.

El agua de inundación causa errosión a las calles de Guadalupe a los caminos del condado y carreteras, y deposita sedimiento y basura en toda el area del proyecto.

Serán Instalados Trabajos de Mejoramiento

Trabajos de mejoramiento propuestos en este plan incluyen tratamiento de la tierra para propositos de ambiente y para la construcción de trabajos estructurales necesitados para reducir el agua de inundacion y daños de sedimiento a el area de la inundación.

El Distrito del Este de Maricopa de Conservacion de Tierras continuará asistiendo en el trabajo del mantenimiento de Los medios para tratamiento de tierras instaladas en los ranchos. El Distrito de Control de Inundaciones del Condado de Maricopa instalará estos medios para el tratamiento de tierras.

La cuidad de Phoenix continuara su programa existente del mantenimiento de el parque South Mountain en su localidad natural del desierto en consistencia con propositos recreacionales.

Una estructura para retener el agua de la inundación será un tubo enterrado y una diversion se instalarán para protejer la comunidad de Guadalupe, el sudeste de Tempe y el area cultivada para reducir los daños causados por el agua de inundación y el sedimiento.

Un periodo de dos años es planeado para este la instalación de este proyecto. El costo total del proyecto sera $693,700 y sera autorizado por la ley publica numero 566 y otros fondos que están demonstrados aquí:

Item	Costos de Proyecto (Dolares) P.L. 566 Fondos	Otros Fondos	Total
Medidas para tratamiento de tierras		20,480 1/	20,480
Medidas Estructurales-Prevencion de Inundaciones	329,410	343,810	673,220
TOTAL	329,410	364,290	693,700

1/ Incluye asistencia técnica de $480.

BENEFICIOS Y COSTOS

El promedio de los beneficios anuales resultando de la instalación de medidas estructurales tiene un prosupuesto de $121,100.

El costo anual promedio de las propuestas medidas estructurales está proyectado a $35,880. La proporción de beneficios anuales promedio a costos anuales medios es 3.4:1.0.

INSTALACION, OPERACION Y MANTENIMIENTO

Medidas para el tratamiento de tierras en tierras privadas serán mantenidas por los rancheros en cooperación con el Distrito del Este de Maricopa de Conservacion de Tierras. El Distrito del Condado de Maricopa Contra las Inundaciones mantendrá las medidas del tratamiento de tierras del ambiente.

El Distrito para control de Inundaciones del Condado de Maricopa construira, operara y mantendrá los trabajos estructurales para el mejoramiento de prevencion de inundaciones.

Acuerdos para la operación y mantenimiento serán ejecutados entre agencias responsables y el Servicio de Conservacion de Tierras antes de dar las invitaciones para posturas. El costo promedio anual para la operación y mantenimiento atribuido a medidas estructurales tiene un prosupuesto de $1,140.

DESCRIPTION OF THE WATERSHED

PHYSICAL DATA

LOCATION AND SIZE

Guadalupe Watershed is located in Maricopa County, Arizona. Portions of the cities of Phoenix and Tempe and the Community of Guadalupe are within the watershed. Guadalupe was settled by Yaqui Indians who fled from Mexico to avoid subjugation by Porfirio Diaz in 1907. The town was named for the Virgin of Guadalupe, patroness saint of Mexico.

The watershed covers 4,590 acres. Interstate Highway 10 traverses the northeast portion of the watershed. This highway is the main link between Tucson and Phoenix.

Pima Wash is the major drainage in the watershed. It originates in the South Mountains and drains northeast for approximately four miles, then turns west and becomes obscure. Approximately one-fourth of the watershed is in South Mountain Park, owned and operated by the City of Phoenix.

LAND USE AND STATUS

The watershed has a total area of 4,590 acres. There are 3,330 acres in private ownership, 140 acres are state owned, and 1,120 acres are owned by the City of Phoenix.

Ownership and Use	Acres		Percent of Area
Private Lands:			
Urban and Commercial	390		8.5
Range and Farmland	2940	(Farm - 1700, Range - 1240)	64.0
Subtotal Private Lands	3330		72.5
State Lands:			
U of A Exp. Sta.	40		.9
Highway Rights-of-way	100		2.2
Subtotal - State Lands	140		3.1
City Lands:			
City Park	1120		24.4
Subtotal - City Lands	1120		24.4
TOTAL	4590		100.0

LAND RESOURCE UNITS

Land resource units are geographic land areas characterized by particular combinations or patterns of topography, soils, climate, water resources, land use and vegetative cover. Two of these units--mountains and valley--exist in this watershed. These units are further described under Topography, Soils, and Cover Conditions in this section of the work plan. The areal extent of these units follows:

Resource Unit	Acres	Percent of Area
Mountains	966	21
Valley	3,624	79
TOTAL	4,590	100

TOPOGRAPHY

The elevations within the watershed range from 2,550 feet (MSL) at the upper reaches of the watershed to 1190 feet (MSL) in the north corner of the watershed. The general land slope is to the northeast.

The Mountain Unit is characterized by steep slopes and is located in the southwest portion of the watershed.

The Valley Unit consists of gentle slopes and is in the area northeast and north of the Mountain Unit.

GEOLOGY

Guadalupe Watershed lies in the Basin and Range physiographic province. The portion of the South Mountains included in the watershed consists of Precambrian granite gneiss and schist. The gently sloping alluvial fan consists of Quaternary-Tertiary gravel, sand, silt, and conglomerate.

SOILS

Soil types and surface conditions vary considerably throughout the watershed. A general description of the soils by land resource units follows:

Mountains - In the mountain unit, the soils are very shallow, rocky, cobbly or gravelly and are residual on granite gneiss or schist. At the bottom of the canyons is a highly dissected soil that consists of deep sandy materials. Slopes range from 10 percent to nearly vertical.

Valley - Deep soils on alluvial fans constitute most of this unit. Medium to moderately fine textured soils are on the smoother slopes located in the lower portion of the watershed. Coarse to moderately coarse textured soils are on the upper fan near the mountains. Slopes range from less than one percent to five percent.

COVER CONDITIONS

The vegetative cover and range conditions for the land resource units follows:

Mountains - The cover condition in this unit is sparse. Desert shrubs dominate the vegetation with lesser amounts of annual grasses and trees. The dominant shrub species are bursage, brickle bush, and creosote bush. The annual grasses consist of red brome, Indian wheat, fiddle neck, spurge, and alfileria. The lack of cover does influence erosion and runoff; however, climatic and soil conditions preclude any significant improvement of the vegetative cover.

Valley - Desert shrubs dominate the vegetation with lesser amounts of annual grasses and trees. Creosote bush and bursage comprise approximately 75 percent of the vegetative cover.

STREAM CHANNELS

There are no perennial streams within the watershed, although Pima Wash is well defined in the upper reaches. The gradient in this area is relatively steep. Pima Wash becomes less defined as the gradients decrease on the alluvial fan. The wash becomes nonexistent in the lower reaches and floodwater spreads out over the floodplain as sheet flow.

CLIMATE

The climate is arid with an average annual precipitation ranging from 7.5 inches in the lower elevations to 10 inches in the upper reaches. During the average year, two precipitation seasons occur, summer and winter. More than 50 percent of the rainfall occurs during July, August and September.

The temperature in this area ranges from 12 to 119 degrees Fahrenheit (F) with a maximum mean of 84.1° F and a minimum mean of 50.5° F. The average annual mean temperature is 67.4° F. Citrus, small grains, and specialty crops are grown throughout the year.

WATER RESOURCES

The domestic water for the town of Guadalupe is supplied by the City of Tempe's water system. The internal distribution system for Guadalupe is not adequate. Positive efforts are being made to improve this system.

The principal source of irrigation water is from the Salt River Water Users' Association water system. A small amount of irrigation water comes from local wells.

E C O N O M I C D A T A

The agricultural economy of the watershed is based primarily on diversified irrigation farming. Cropland occupies 1,700 acres or approximately 37 percent of the watershed; 1,240 acres are in rangeland and 1,650 acres are for miscellaneous use, (city park, town of Guadalupe, etc.). The average land value in the watershed is estimated at $2,000 per acre for upland and $4,000 per acre for irrigated and urban lands.

There are 17 farms including two dairies and two cattle feeding operations within the watershed boundary and of these 17, three are family farms. The average size of a farm is about 100 acres. There are no low income producing units. Crops grown are: alfalfa, citrus, cotton, feed grains, nursery crops, pasture and vegetables. Most of the farms are leased and the operators do not live on the farms. Four farms use one and one-half man-years or more of hired labor. Seasonally, agricultural workers harvest, transport and process crops grown.

The watershed has a population of approximately 6,000 people. Of this total, 5,900 are considered urban dwellers while 100 are rural dwellers. However, studies indicate the urban population will significantly increase in the near future. Urban development is projected for the entire floodplain below the Highline Canal by 1985.

The town of Guadalupe is considered to be an economically depressed area. Residents of this community have a great need for additional employment opportunities. The people have formed the Guadalupe Organization, Incorporated (GO) to improve their town and well-being. The Office of Economic Opportunity financially assists GO in meeting their objectives. Some of their successful activities are an adult education program, a credit union, health and dental clinics, and a limited job placement program.

This watershed is located within the proposed Hohokam Resource Conservation and Development Project area.

L A N D T R E A T M E N T D A T A

Cooperators of the East Maricopa Soil Conservation District are actively applying the conservation treatment needs of this watershed. It is estimated that 80 percent of the needed land treatment measures have already been applied.

There are 11 Soil Conservation District cooperators and of these, 10 have conservation plans. Approximately 25 percent of the total watershed is covered by agreements with the East Maricopa Soil Conservation District.

The City of Phoenix administers 94 percent of the drainage area above the town of Guadalupe. South Mountain Park is maintained in its natural desert condition and is used for recreation purposes. No land treatment measures are needed on the park land.

The watershed is divided into two resource units, the mountain unit and valley unit. The mountain resource unit has a land capability class of VII and VIII. The valley unit is divided into two other units, irrigated and nonirrigated. The irrigated unit, located northeast and east of the town of Guadalupe, has capability classes of I and II. The non-irrigated unit has a capability class of VII.

Major land use changes are foreseen by 1985. Most of the land below South Mountain Park will be urbanized.

F I S H & W I L D L I F E R E S O U R C E D A T A

There are no streams or ponds in this watershed in which to propagate fish.

The size, vegetative cover, and the physiographic features restrict the wildlife resources to a few species of desert wildlife.

WATERSHED PROBLEMS

No important land treatment problems were encountered in this watershed. Over 80 percent of the needed land treatment measures have already been applied. Due to the rapid urban expansion of the area and the amount of land treatment already applied, land treatment needs will be met by follow-up and maintenance.

The principal watershed problems are floodwater and sediment damages to agricultural and nonagricultural properties. Existing agricultural damage consists primarily of damage to crop and pasture, irrigation canals, other agricultural facilities and interruption of irrigation water deliveries. However with the expected urban development of the floodplain, future damages will be largely nonagricultural. Nonagricultural damages will occur to residential, commercial, industrial, railroad, highway, and street properties. Total average annual damages during the project evaluation period are estimated at $274,910.

Most floods originating in Guadalupe Watershed result from high intensity cloudburst summer storms. These storms may be centered anywhere in the watershed. During the storms of September 14 and 16, 1969, damages occurred as muddy floodwater flowed through the community of Guadalupe and down to the Western Canal. Future damages from a flood of this magnitude could cost a million dollars or more in repairs. A flood of this size can be expected to occur on the average of once in 30 years.

Records show that major floods have occurred in 1934, 1952, 1965, and 1969. The September 1969 event was the key flood studied.

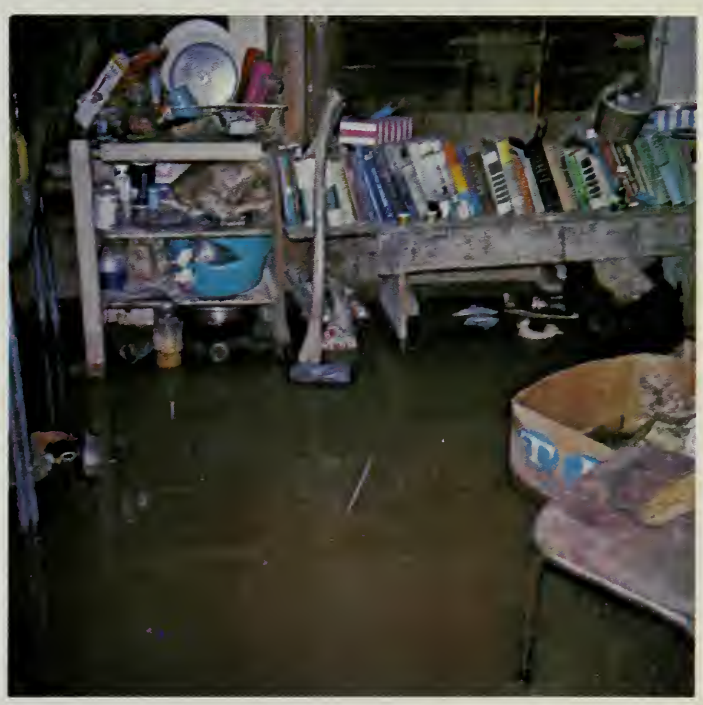
F L O O D W A T E R D A M A G E

Floodwaters cause much damage in the town of Guadalupe. Floodwaters originating in the South Mountains flow into the town of Guadalupe by way of Pima Wash and the culverts under the highway (Interstate 10).

Floodwaters cause grief and hardship to the economically depressed.

Misery is compounded by a second flood in three days.

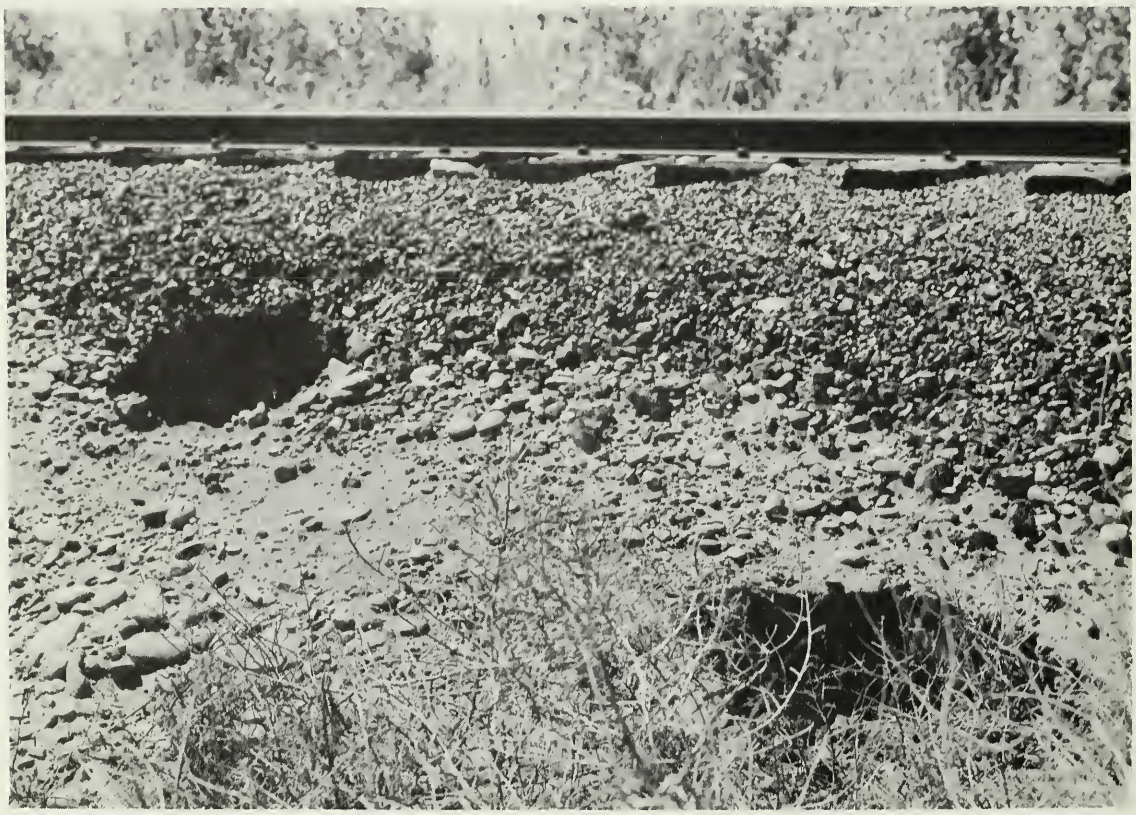
Sleep is restless while flood waters recede.



College scholarship forfeited.

Pictures courtesy of Guadalupe Organization, Incorporated. Cost of printing was provided by the East Maricopa Soil Conservation District.

The 1969 storm caused serious damage to agricultural properties by breaking about one-half mile of main canal lining, silting irrigation ditches and inundating over 600 acres of crops. This storm also damaged an estimated 137 homes and 18 commercial properties. Floodwater also damaged railroad and industrial properties.



Damage resulting from floodwater and soil erosion.

The floodwaters fill cesspools and cause unsanitary conditions. About 64 percent of the sanitation facilities within the community of Guadalupe are outdoor pit toilets. Flooding of these toilets creates an unhealthy, stinking mess. In some areas floodwaters pond and these toilets are not usable for days. After filling the cesspools, and flowing through the town, the water ponds against the bank of the Highline Canal to a depth of a foot or more before overtopping the canal. The ponded water quickly stagnates and becomes a thriving habitat for mosquitoes.

Floodwaters damage outdoor privies and fill cesspools creating a stinking mess.

Floodwater damage to crop and pasture, irrigation canals, irrigation interruption and other agricultural properties from the 1969 flood event was estimated to be $34,200. The floodwater damage to residential, commercial, industrial, railroad, streets, roads and highway from the 1969 flood event was estimated to be $97,600. Floodwater from an equal size event occurring in 1985 could cause about $850,000 damage.

S E D I M E N T D A M A G E

Floodwater deposits sediment and trash in homes, yards and on streets. Debris is also deposited on the alluvial fan.

Sediment causes damage to agricultural properties by smothering crops. Sediment deposition in irrigation ditches prevents the proper distribution of water causing crop loss. Releveling of fields is sometimes necessary because of sediment deposition. Weed infestation is a by-product of sediment deposition on crop land.

Sediment halts irrigation water deliveries and reduces crop yield.

The sediment damage to agriculture from the 1969 flood was estimated at $23,400. The sediment damage to nonagricultural properties from the 1969 flood event is estimated to be $42,300. Sediment from an equal size event occurring in 1985 could cause an estimated $465,000 damage.

INDIRECT DAMAGES

Indirect flood damages resulting from floods or the threat of floods are significant because of development within the floodplain. Indirect damages include the cost of flood prevention measures, loss of production time and inconvenience resulting from cleanup and removal of sediment due to flooding. Possible disease or physical discomfort from the adverse effects of flooding and inconveniences resulting from unrepaired damages due to lack of capital is also considered as an indirect damage. The indirect damage from the 1969 flood event was estimated to be $20,500.

WATER MANAGEMENT PROBLEMS

Irrigation

All of the cropland, 1,700 acres, in the watershed is under irrigation. Most of the irrigation water comes from the Salt River Water Users' Association irrigation water supply. Some water is also supplied by local wells. With the rapid expansion and urbanization of this area, no irrigation water problems are anticipated.

Municipal and Industrial Water

Guadalupe receives its water from the City of Tempe. The water distribution system in Guadalupe is inadequate. Plans are being made to alleviate this distribution problem.

Recreation

A portion of the City of Phoenix South Mountain Park is located in the watershed. Picnic facilities are located in the park. The nearest water-based recreation facility is located about 40 miles away at Saguaro Lake.

Future water-based recreation in or near the watershed was not considered.

Fish and Wildlife

The limited amount of annual precipitation, the sparse ground cover, and the small size of the watershed has limited the wildlife resource to a few species of desert wildlife.

PROJECTS OF OTHER AGENCIES

The Bureau of Reclamation Highline and Western canals administered by the Salt River Water Users' Association are located within the watershed. The Western Canal will serve as a means of disposal for floodwater releases from the floodwater retarding structure. The outlet pipeline will cross under the Highline Canal. The structural works of improvement will reduce floodwater damages to the Highline and Western canals and reduce the frequency of ponding on the upstream banks of the canals.

PROJECT FORMULATION

PROJECT OBJECTIVES

The project objectives agreed upon represent a unified effort by the local people. The objectives are:

1. Establish land treatment and structural measures which will contribute directly toward watershed protection and flood prevention.

2. Protect productive farmland from floodwater and sediment damage.

3. Reduce floodwater and sediment damage to irrigation canals and ditches.

4. Reduce floodwater inundation and sediment deposition to residential and commercial properties.

5. Reduce sediment and floodwater damage to roads and highways.

Project formulation, including land treatment and structural measures, was determined after consideration of various alternatives that would meet the sponsors' objectives and be within the Soil Conservation Service standards and policies.

LAND TREATMENT MEASURES

Approximately 80 percent of the needed land treatment measures have already been applied. Due to the amount of treatment already applied and the rapid urban expansion, the only land treatment measures recommended are those that are to be installed on or near the structural measures for environmental purposes. The land treatment time necessary during project installation will be for installing the recommended environmental land treatment measures and for follow-up and maintenance of the measures already applied.

STRUCTURAL MEASURES

The selected structural works of improvement were determined after considering alternative plans of structural formulation that would provide a high degree of flood protection and sediment control. In selecting the structural measures, consideration was given to the economic, geologic, and topographic factors involved.

Three alternative plans were considered. The best structural alternative consists of a floodwater retarding structure, a diversion, and a buried pipeline to convey floodwater releases from the floodwater retarding structure to the Western Canal.

A discussion of the alternative studies is included in the investigation and analysis section of this plan.

The desired level of flood protection and project development was determined after considering the present and future growth of the area. In consideration of the urban nature of the watershed, protection from flood events of the magnitude expected once in 100 years will be provided.

The unimproved south portion of the watershed, for about three-fourths mile north of Elliott Road, will not receive protection from flooding. No feasible means of providing such protection was found.

The structures will control 1.87 square miles or 26 percent of the watershed. This 1.87 square miles contributes the majority of the damaging floodwaters.

OTHER RESOURCE CONSIDERATION

Other pertinent factors that reflect the adequacy of the plan to meet the problems of the watershed and desires of the local sponsors were considered.

The Bureau of Sport Fisheries and Wildlife of the Fish and Wildlife Service and the Arizona Game and Fish Department agreed that construction and operation of the proposed Guadalupe Watershed Project would not significantly affect fish or wildlife resources in the watershed. No further studies are deemed necessary.

WORKS OF IMPROVEMENT TO BE INSTALLED

LAND TREATMENT MEASURES

Land treatment measures for environmental purposes will include plantings of native trees, shrubs, cacti and herbaceous plants. Native cacti and other selected shallow-rooted plants will be established on the downstream slopes of the embankments of the diversion and the floodwater retarding structure (FRS) which consists of three embankments. Trees and larger shrubs will be planted in front (downstream side) of the embankments. The proposal will complement the recently landscaped section of Interstate Highway 10 (I-10). Overall, the landscaping will blend the structural measures into the natural setting.

Plantings can be established and/or maintained by installing an irrigation system. Water for irrigation purposes is available from existing water lines. The proposed irrigation system will consist of pipelines originating at take-off points on Beverly Road and Sonora Street west of I-10. The irrigation pipeline originating on Beverly Road will supply water to the Saddle Dike and Center Section embankments of the FRS. The irrigation pipeline originating near Sonora Street extending in a north-south direction will supply water to the diversion and the I-10 portion of the FRS. The total cost of installing these measures is estimated at $20,000. The land treatment measures for environmental purposes are the only land treatment measures recommended for this watershed.

STRUCTURAL MEASURES

The proposed structural measures will include three interrelated features; a floodwater retarding structure (FRS), a diversion, and a buried pipeline. The diversion will divert flood flows into the floodwater retarding structure and the retarded floodwater will be conveyed by the buried pipeline to the Western Canal, about one mile north of the FRS. These features will provide protection from a flood that will not be equalled or exceeded on the average of more than once in 100 years (100 year flood), and limit the discharge into the Western Canal to 23 cubic feet per second. The maximum allowable discharge from the FRS into the Western Canal provided for by the Salt River Project is 33 cubic feet per second.

The foundation materials for the FRS and diversion range from granite to sandy silt. Most of the granite is found in the abutments of the FRS. The fine silty sand and the sandy silts found along portions of the foundation may be subject to rapid consolidation upon saturation and loading.

The total estimated installation cost of the structure is $673,220. (See Table 2.)

Guadalupe Floodwater Retarding Structure (FRS)

The Guadalupe FRS will be constructed northwest of Guadalupe at an estimated installation cost of $453,100. The dam will be a homogeneous earth-fill embankment with a storage capacity of 290 acre feet that includes 25 acre feet for the 100 year sediment storage. The sediment pool will be gated to permit temporary retention of water and releases at a rate consistent with the capacity of the Western Canal. Rock riprap will be placed on the upstream face of the embankment from natural ground elevation to two and one-half feet above the crest of the principal spillway riser.

The Guadalupe FRS is separated into three sections; the center section, the I-10 section and the saddle dike section. The three sections are separated by granite hills, which serve as abutments for the center and saddle dike sections, and as the north abutment for the I-10 section.

Center Section: This section of the FRS will have a crest length of approximately 940 feet with a maximum height of 35 feet. The principal spillway will be located in this section and will consist of a standard rectangular open top drop inlet riser with a thirty inch reinforced concrete conduit through the dam embankment. A pressure manhole will be located near the downstream toe of the embankment. The crest of the single-stage riser will be at the elevation of the 100 year sediment storage. The riser is gated to allow for drainage of the sediment pool. The maximum release rate from the principal spillway will be 23 cfs. Additional structural data is shown in Table 3.

I-10 Section: This section is located adjacent and parallel to Interstate Highway 10. The maximum height of fill is 30 feet, with a crest length of about 1960 feet. The north abutment of this structure is on a granite hill. The south abutment joins the diversion embankment at a point approximately 1300 feet north of Guadalupe Road.

The construction of this structure will necessitate the relocation of one electric power pole.

Saddle Dike Section: This section will have a crest length of about 470 feet with a maximum height of 23 feet. Both abutments will be located in granite hills.

Construction of the saddle dike will require the relocation of two 10-3/4 inch O.D. El Paso Natural Gas lines. The gas lines will be relocated in the left abutment of the saddle dike at an elevation above the maximum water level attained by the flood routing of the emergency spillway hydrograph. Approximately 1200 feet of each gas line will be relocated and concrete anchors will be installed at intervals for an additional 500 feet of line.

The emergency spillway will be located in the granite hill that separates the saddle dike and center sections of the FRS. The spillway will be a rectangular section excavated entirely in granite rock, with a 30 foot length control section. The spillway will be 200 feet wide.

Guadalupe Diversion

The diversion is located adjacent and parallel to Interstate Highway 10. The diversion begins at a point approximately 1250 feet south of Guadalupe Road and terminates approximately 1300 feet north of Guadalupe Road. The diversion will direct flood flows from the southern portion of the watershed into the FRS.

The diversion consists of three sections: an excavated earth channel with earth fill embankment for those reaches north and south of Guadalupe Road, and a 95 inch x 67 inch pipe arch tunnel liner conduit installed underneath the Interstate Highway 10 Guadalupe Road overpass.

The diversion will have sufficient capacity to control the 100-year flood.

A backwater effect will exist in that portion of the diversion located upstream from the pipe arch conduit. Additional embankment height was added to allow for sediment deposition in this reach. The diversion has been designed to accommodate a 100-year accumulation of sediment and still safely pass a 100-year flood.

The 100-year flood will be contained in cut sections for approximately 70 percent of the length of the diversion. Banquettes will be constructed for the entire berm width between the excavated channel and embankment for all reaches where the 100-year flow will not be in a cut section. The top of the banquettes will be at an elevation equal to or above the water surface elevation attained by the 100-year flood. The 10-year flood will be contained in cut sections for the entire length of the diversion.

North of Guadalupe Road, the diversion embankment is basically an extension of the dam embankment for the I-10 portion of the FRS.

Reinforced concrete headwalls will be constructed at the entrance and exit to the Guadalupe Road tunnel conduit. The diversion channel immediately upstream and downstream from the tunnel conduit will be stabilized with rock riprap to prevent erosion in the vicinity of the concrete headwalls.

See Table 3a for additional structural data.

The construction of the diversion will necessitate the lowering of AT&T's transcontinental telephone cable. The diversion also crossed a six inch natural gas line located south of Guadalupe Road; however, this gas line has sufficient cover. Lowering of the line should not be required if caution is exercised during construction.

Outlet Pipeline

A buried 21 inch diameter concrete pipeline will convey the floodwater releases from the Floodwater Retarding Structure to the Western Canal. The pipeline will be approximately 5470

feet in length. A 30 inch x 21 inch transition section will be installed as a transition from the 30 inch principal spillway conduit into the 21 inch outlet pipeline.

The pipeline will cross Beverly Road, which is an unpaved county road, the Highline Canal, and Baseline Road, which is a main four-lane East-West thoroughfare. The pipeline will also cross a four inch natural gas line and an eight inch water line, both located immediately north of Beverly Road; a two and one-half inch natural gas line and a twelve inch water main, both located immediately south of Baseline Road; and a buried Mountain States Telephone cable located under the south levee of the Western Canal.

The estimated installation cost of the pipeline is $109,650.

EXPLANATION OF INSTALLATION COSTS

LAND TREATMENT MEASURES

The estimated cost of $20,000 for installing the land treatment measures for landscaping purposes will be borne by the Flood Control District of Maricopa County. The estimated cost of $480 for the follow-up and maintenance of the already applied land treatment measure will be borne by the going conservation program of the East Maricopa Soil Conservation District. (See Table 1.)

STRUCTURAL MEASURES

The total installation cost for structural measures includes cost of construction, engineering services, project administration, state dam filing fees and land rights. A tabulation of the installation costs is shown in Table 2 of this plan.

CONSTRUCTION

The construction costs shown in the engineer's estimate were based on recent contract data for P.L. 566 projects in Arizona and selected U.S. Bureau of Reclamation contract data in Maricopa County. The Arizona Highway Department's annual publication relating to unit bid costs of highway construction items was also used in preparation of the cost estimates. The estimated construction cost includes contingency factors of from 15 percent to 20 percent.

ENGINEERING SERVICES

The cost of engineering services includes services of engineers, hydrologists and geologists for surveys, site investigations, soil mechanics, structural designs, flood routing, and construction plans and specifications. Engineering costs are estimated at 20 percent of the construction cost. (Table 2)

PROJECT ADMINISTRATION

The costs of project administration are the P.L. 566 and other administration costs associated with the installation of structural measures including the cost of contract administration, review of engineering plans prepared by others, government representatives, construction layout, and necessary inspection service during construction to insure that structural measures are installed in accordance with the plans and specifications. Project administration costs for P.L. 566 and other funds are estimated at ten and one percent of the construction cost, respectively. The State of Arizona dam filing fee is an additional administrative cost.

LAND RIGHTS

Land rights costs were determined from a right-of-way acquisition report made for the Guadalupe flood control project by the State Highway Department and through meetings with the sponsoring local organizations.

Land rights include cost for land acquisition, easements, rights-of-way, relocation of utilities and other improvements, and the installation of public highway culvert crossings. Included are elements of work involving construction and engineering services directly associated with land rights. The major land rights costs are those for land acquisition and right-of-way, estimated at $222,930. However, this does not preclude the possibility of the purchase or donation of flowage easements in lieu of direct land purchases. Relocations and changes of utilities include two gas line relocations estimated at $84,000; one power pole relocation estimated at $600; the lowering of one AT&T cable estimated at $780, and the installation of the Guadalupe Road tunnel conduit, estimated at $30,460.

COST SHARING

Installation costs will be shared by the local sponsoring organizations and the federal government in accordance with the requirements of Public Law 566, as amended, and the Secretary's Policy Statement.

The total estimated installation cost of the project is $693,700 of which $329,410 are from P.L. 566 funds and $364,290 are from other funds.

P.L. 566 Funds

The following will be borne by P.L. 566 funds:

1. The construction cost of the structural measures for flood prevention. (Estimated cost $246,360.)

2. The cost of the engineering services for all structural measures. (Estimated cost $55,360.)

3. Project administration costs incurred by the federal government. (Estimated cost $27,690.)

Other Funds

The following will be borne by other funds:

1. The cost of installing land treatment measures for landscaping purposes. (Estimated cost $20,000.)

2. Cost of technical assistance for the existing land treatment program. (Estimated cost $480.)

3. Project administration cost incurred by the sponsors. (Estimated cost $4,380.)

4. Total cost of land rights for the structural measures. (Estimated cost $339,430.)

EXPECTED EXPENDITURES OF FUNDS BY FISCAL YEARS

Guadalupe Watershed, Arizona
(Dollars)

	FISCAL YEARS		
	1	2	Total
P.L. 566 Funds			
Construction		246,360	246,360
Engineering Services	55,360		55,360
Project Administration	5,000	22,690	27,690
Total - P.L. 566 Funds	60,360	269,050	329,410
Other Funds			
Land Treatment - SCS			
Landscape Measures		20,000	20,000
Technical Assistance	240	240	480
Project Administration		4,380	4,380
Land Rights	222,930	116,500	339,430
Total - Other Funds	223,170	141,120	364,290
TOTAL	283,530	410,170	693,700

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EFFECTS OF WORKS OF IMPROVEMENT

The proposed works of improvement will substantially reduce floodwater and sediment damages within the watershed. Installation of the structural measures will control the runoff from 1.87 square miles or 26 percent of the total watershed. This 1.87 square miles contributes the majority of the damaging floodwaters.

The works of improvement will benefit approximately 1,290 acres by reducing flood depths and/or acres inundated for a storm occurring over the entire watershed area.

When a 100-year storm occurs only above the structure site, the works of improvement will completely eliminate the possibility of flooding on 684 acres, with a corresponding elimination of floodwater depths ranging up to three feet in some locations.

Residual damages will continue to occur after the project is installed. The structural measures will control floods originating above them, but the protected area, especially that below the Highline Canal, will still be subject to damage from local runoff. The south portion of the watershed, beginning about one-fourth mile south of Guadalupe Road (see Project Map) will not receive any protection from project structural measures. Due to the nature of flows on an alluvial fan combined with the effects of man-made improvements, the region between that area and Guadalupe Road will still be subject to minor damage from flow originating south of the structural measures.

There are 856 homes in the community of Guadalupe and 69 homes within a subdivision in the City of Tempe. The projection plan of Tempe shows that by 1985, all of the agricultural land in the floodplain area will be converted to urban use.

To insure that all new home foundations will not be lower than the 100-year flood elevation, the Flood Control District of Maricopa County in coordination with the Maricopa County Planning and Zoning Committee will continue the existing policy of 100-year protection. For that portion of the watershed area within the City of Tempe, the Flood Control District of Maricopa County has notified the City of Tempe and the Federal Housing Administration of appropriate floodproofing measures.

PROJECT BENEFITS

Total flood prevention benefits accruing to project structural measures are estimated to be $121,100 annually. Direct flood damage reduction benefits amount to $110,040, reductions in indirect damages, $11,060.

Direct agricultural damage reduction benefits, including crop and pasture, irrigation canals, irrigation interruption and other agricultural properties are estimated to be $1,790 annually. This includes $1,320 for floodwater and $470 for sediment damage reductions.

Direct damage reduction benefits to nonagricultural properties consisting of residential, commercial, highway and street properties are estimated at $108,250. This includes $70,090 for floodwater and $38,160 for sediment damage reductions.

Reduction of indirect losses is estimated to be $11,060 annually. Of this amount, $170 is for agricultural and $10,890 for nonagricultural properties.

Secondary benefits were not evaluated.

Also unevaluated are incidental health benefits which result from decreased flooding of pit toilets and cesspools and improved vector control through less frequent ponding.

COMPARISON OF BENEFITS AND COSTS

The structural measures outlined in this plan are economically feasible. The average annual benefits to accrue as a result of the installation of the proposed structural measures are estimated to be $121,100. The average annual cost of the proposed structural measures are estimated to be $35,880. The ratio of average annual benefits to average annual costs is 3.4:1.0.

PROJECT INSTALLATION

The installation of the structural measures will be a joint undertaking by both the federal and non-federal interests. Non-federal interests include the Flood Control District of Maricopa County, the East Maricopa Soil Conservation District, the City of Phoenix and the State of Arizona. Federal interests include the Agricultural Stabilization and Conservation Service and the Soil Conservation Service of the Department of Agriculture. In order to coordinate the installation of these "measures", close coordination and specific responsibilities will be required of all interests involved.

The East Maricopa Soil and Water Conservation District and the Flood Control District of Maricopa County will have the primary responsibility for accomplishing the proposed plan.

East Maricopa Soil and Water Conservation District will:

1. Provide technical assistance to land owners and operators in the District.

2. Conduct an information and education program as needed to properly inform local people of the project.

Flood Control District of Maricopa County will:

1. Carry out and assume the responsibility and all liability for the construction, operation, and maintenance of structural measures.

2. Acquire all land rights needed in connection with the works of improvement. The power of eminent domain will be exercised if necessary.

3. Act as contracting organization for the construction of all structural measures.

Agricultural Stabilization and Conservation Service will:

Provide Federal cost-sharing assistance in accordance with existing Agricultural Stabilization and Conservation Service policies and procedures to individual farmers and ranchers in applying approved conservation practices on their farms and ranches.

Soil Conservation Service will:

1. Furnish technical assistance through the East Maricopa Soil and Water Conservation District to the private landowners for the follow-up and maintenance of land treatment measures already applied.

2. Furnish engineering services for engineering surveys, design, land rights work map, construction plans and specifications for structural works of improvement for flood prevention and inspection during construction.

3. Allot PL-566 construction funds in accordance with cost sharing and the installation schedule as outlined in this plan or as may be revised by mutual agreement. Allocations of funds will be in accordance with national priorities and availability at the time of installation.

4. Maintain liaison with sponsors, state and federal agencies involved so that the objectives outlined in this plan will be accomplished for the benefit of all concerned.

A two year installation period is planned for the project.

During the first year, all land, easements and rights-of-way will be secured. All necessary surveys, investigations and detailed designs will be completed.

During the second year, the installation of all structural and land treatment measures will be completed. All elements of land rights, including elements of work involving construction and engineering services directly associated with land rights will be completed.

FINANCING PROJECT INSTALLATION

The project installation costs allotted to PL-566 will be paid from funds appropriated under the authority of PL-566, 83d Congress, 68 Stat. 666 as amended. This work plan does not constitute a financial document for obligation of federal and other funds. Financial or other assistance to be furnished by the Soil Conservation Service in carrying out the plan is contingent on the appropriation of funds for this purpose.

The cost of installing the environmental land treatment measures will be borne by the Flood Control District of Maricopa County. Technical assistance required for the follow-up and maintenance of the land treatment measures already applied will be provided by the Soil Conservation Service under the going program.

The installation costs for structural measures not borne by PL-566 funds will be the responsibility of the Flood Control District of Maricopa County. The District has analyzed its financial needs in consideration of the scheduled works of improvement so that funds will be available when needed through cash resources or tax and assessment levies. The local sponsors' share of the installation cost referred to as land acquisition, easements, and rights-of-way will be negotiated for or acquired by eminent domain.

PROVISIONS FOR OPERATION AND MAINTENANCE

LAND TREATMENT MEASURES

The Flood Control District of Maricopa County will be responsible for operation and maintenance of the environmental land treatment measures installed for the enhancement of natural beauty.

STRUCTURAL MEASURES

The Flood Control District of Maricopa County will be responsible for the operation and maintenance of all structural measures after they are installed. The District will obtain all necessary funds for operation, maintenance, and replacement from tax or assessment levies. Agreements may be made between the Flood Control District and the Salt River Project for the operation of the gate to drain the sediment pool.

A sponsor's representative and a Soil Conservation Service employee will make a joint annual inspection during the first three years after the installation of the structure. Annual inspections will be made by the sponsors after the three-year period and a report will be sent to the designated SCS employee. Inspection will also be made after unusually large floods.

An operation and maintenance agreement will be entered into between the sponsors and the Soil Conservation Service prior to the issuance of invitation to bid.

The total annual operation, maintenance, and replacement cost of structural measures is estimated to be $1,140.

It is agreed that representatives of the federal, state and county governments shall have free access at all times to the structural works of improvement for official activities.

All phases of operation and maintenance of these facilities shall comply with applicable local, state and federal regulations.

Items considered necessary for proper operation and maintenance of the structural works of improvement shall include, but are not limited, to the following:

OPERATION

The structural measure for flood prevention is automatic in its operation. The gated sediment pool shall be drained into the Western Canal as soon as irrigation schedules permit.

MAINTENANCE

To insure proper functioning of the structural works, periodic maintenance will be required.

The structures are to be maintained by making repairs and replacements as needed.

All trash and obstructions should be removed from the spillway inlet.

Repairs to structures and structural features damaged by floods will be made promptly.

Sediment deposits and weeds are to be removed from the diversion channel to maintain its capacity for floodwater.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Guadalupe Watershed, Arizona

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/ P.L. 566	Non-Federal Land Other	Total
LAND TREATMENT					
Soil Conservation Service					
Landscaping	ac.	10		20,000	20,000
Cropland	ac.	1,700			
Technical Assistance				480	480
TOTAL LAND TREATMENT				20,480	20,480
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Structure	no.	1	155,780		155,780
Diversion	ft.	2,550	11,920		11,920
Pipeline	ft.	5,470	78,660		78,660
Subtotal - Construction			246,360		246,360
Engineering Services					
Soil Conservation Service			55,360		55,360
Subtotal - Engineering Services			55,360		55,360
Project Administration					
Soil Conservation Service					
Construction Inspection			16,830		16,830
Other			10,860	4,380	15,240
Subtotal - Project Administration			27,690	4,380	32,070
Other Costs					
Land Rights				339,430	339,430
Subtotal - Other Costs				339,430	339,430
TOTAL STRUCTURAL MEASURES			329,410	343,810	673,220
TOTAL PROJECT			329,410	364,290	693,700

1/ Price base 1970 prices.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At Time of Work Plan Preparation)

Guadalupe Watershed, Arizona

Measures	Unit	Applied To Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Chiseling and Subsoiling	ac.	690	3,450
Conservation Cropping System	ac.	1,448	1,450
Crop Residue Management	ac.	1,462	15,600
Irrigation Ditch and Canal Lining	ft.	37,469	37,470
Irrigation Field Ditch	ft.	5,960	600
Irrigation Land Leveling	ac.	1,176	82,320
Irrigation Pipeline	ft.	9,300	32,550
Irrigation Water Management	ac.	395	1,580
Minimum Tillage	ac.	1,135	1,130
Structure for Water Control	no.	297	4,450
Well	no.	1	50,000
TOTAL			230,600

1/ Price base: 1970 Prices

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Guadalupe Watershed, Arizona

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds			Installation Cost Other Funds		Total Instal. Cost
	Construction	Engineering	Total P.L. 566	Land Rights	Total Other	
Floodwater Retarding Structure	$155,780	$31,160	$186,940	$266,160 2/	$266,160	$453,100
Diversion	11,920	8,470	20,390	58,010 3/	58,010	78,400
Pipeline	78,660	15,730	94,390	15,260 4/	15,260	109,650
Subtotal	$246,360	$55,360	$301,720	$339,430	$339,430	$641,150
Project Administration	xxx	xxx	27,690	xxx	4,380 5/	32,070
GRAND TOTAL	$246,360	$55,360	$329,410	$339,430	$343,810	$673,220

1/ Price base 1970 prices.
2/ Includes $181,500 for right-of-way, $84,000 for relocation of two natural gas lines, $600 for power pole relocation, and $60 for clothes line relocation.
3/ Includes $26,650 for right-of-way, $30,460 for Guadalupe Road tunnel conduit, $780 to lower AT&T cable and $120 for utility company inspectors.
4/ Includes $14,780 for right-of-way, $250 for utility company inspectors, and $230 for Baseline Road pavement repair.
5/ Includes $1,610 for State of Arizona Dam filing fees.

TABLE 3 - STRUCTURAL DATA

FLOODWATER RETARDING STRUCTURE

Guadalupe Watershed, Arizona

ITEM	UNIT	TOTAL
Class of Structure		c
Drainage Area	Sq. Mi.	1.87
Controlled	Sq. Mi.	1.87
Curve No. (1-day) (AMC II)		93
Tc	Hrs.	0.70
Elevation Top of Dam	Ft.	1282.6
Elevation Crest Emergency Spillway	Ft.	1275.9
Elevation Crest Principal Spillway	Ft.	1258.7
Maximum Height of Dam	Ft.	35.0
Volume of Fill	Cu. Yds.	171,660
Total Capacity	Ac. Ft.	290.0
Sediment Storage 100 Years	Ac. Ft.	25.0
Retarding	Ac. Ft.	265.0
Surface Area		
Sediment Pool	Acres	5.7
Retarding Pool	Acres	30.4
Principal Spillway		
Rainfall Volume (areal) (1 day)	In.	3.96
Rainfall Volume (areal) (10 day)	In.	6.35
Runoff Volume (10 day)	In.	4.55
Capacity at Crest of Emergency Spillway	cfs.	23
Frequency Operation - Emer. Spillway	% Chance	1
Size of Conduit	Diameter - In.	30
Emergency Spillway		
Rainfall Volume (ESH) (areal)	In.	7.70
Runoff Volume (ESH)	In.	6.87
Type		Rock
Bottom Width	Ft.	200
Velocity of Flow (V_e)	Ft./Sec.	8.08
Slope of Exit Channel	Ft./Ft.	.03
Maximum Water Surface Elevation	Ft.	1278.43
Freeboard		
Rainfall Volume (FH) (areal)	In.	19.0
Runoff Volume (FH)	In.	18.13
Maximum Water Surface Elevation	Ft.	1282.55
Capacity Equivalents		
Sediment Volume	In.	0.25
Retarding Volume	In.	2.66

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TABLE 3A - STRUCTURE DATA

GUADALUPE DIVERSION

Guadalupe Watershed, Arizona

Channel Designation	Stations or Reach	Drainage Area Acres	Capacity cfs Required	Capacity cfs Design	Water Surface Elev. 1/	Hydraulic Gradient (Ft/Ft)	Average Channel Dimensions Bottom(Ft)	Average Channel Dimensions Depth(Ft) 2/	"N" Values Aged	"N" Values As Built	Average Velocities Ft/Sec Aged	Average Velocities Ft/Sec As Built	Type of Channel Improvement
Guadalupe Diversion	3+50	Begin Diversion Dike											
	5+50	Diversion Dike 90° turn west to north											
	3+50 to 6+50	Dike only - No channel other then existing washes											Dike
	6+50	20	60	120	Begin channel portion of diversion								
	6+50 to 15+80	20 to 40	60 to 120	120		.001	25	6.0	.03	.02	3/	3/	Earth
	15+80 to 16+00	40	120	120	1284.1	.001	25	6.0	.035	.035	3/	3/	Riprep
	16+00 to 17+10	40	120	120	1281.8	Guadalupe Road Conduit. Instell by tunneling a 95' x 67' pipe arch tunnel liner conduit.							
	17+10 to 17+30	40	120	166	1281.2		25	6.0	.035	.035	2.8	3.8	Riprep
	17+30 to 30+10	40 to 60	120 to 166	166	1278.6	.002	25	6.0	.03	.02	2.8	3.8	Earth
	30+10	End Diversion. Equels Sta. 39+26 of Floodweter Retarding Structures											

Oesign Storm Frequency: 1%
Side Slopes: 5 Hor.: 1 Vert.
3 Hor.: 1 Vert.

1/ Weter surfece elevetion is for d/s station in reach.
2/ Oepth (Ft) is from bottom of chennel to top of diversion dike.
3/ Backweter condition because of Guadelupe Road Conduit.

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TABLE 4 - ANNUAL COSTS

Guadalupe Watershed, Arizona

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structure	23,380	620	24,000
Diversion	4,050	210	4,260
Pipeline	5,660	310	5,970
Project Administration	xxx	xxx	1,650
GRAND TOTAL	33,090	1,140	35,880

1/ Price Base - Installation - 1970: O&M - Normalized

2/ 100 years @ 5-1/8 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Guadalupe Watershed, Arizona

(Dollars) 1/

Item	Estimated Average Annual Damage Without Project	With Project	Damage Reduction Benefit
Floodwater			
Agricultural			
Crop and Pasture	910	640	270
Irrigation Canals	660	470	190
Irrigation Interruption	1,540	930	610
Other Agricultural	830	580	250
Nonagricultural			
Residential	154,460	86,190	68,270
Commercial	640	320	320
Industrial and Railroad	280	150	130
Streets, Roads and Highway	2,370	1,000	1,370
Subtotal	161,690	90,280	71,410
Sediment			
Agricultural			
Crop and Pasture	610	430	180
Irrigation Canals	160	110	50
Other Agricultural	810	570	240
Nonagricultural			
Residential	85,620	47,950	37,670
Commercial	310	160	150
Industrial and Railroad	20	10	10
Streets, Roads and Highway	580	250	330
Subtotal	88,110	49,480	38,630
Indirect	25,110	14,050	11,060
TOTAL	274,910	153,810	121,100

1/ Price Base: Adjusted Normalized Price Levels

January 1971

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Guadalupe Watershed, Arizona

(Dollars)

Evaluation Unit	Average Annual Benefits		Average Annual Costs 2/	Benefit Cost Ratio
	Damage Reduction 1/	Total		
Floodwater Retarding Structure, Pipeline and Diversion	121,100	121,100	34,230	3.5:1.0
Project Administration	xxx	xxx	1,650	xxx
GRAND TOTAL	121,100	121,100	35,880	3.4:1.0

1/ From Table 5

2/ From Table 4

January 1971

INVESTIGATION AND ANALYSES SECTION

GUADALUPE WATERSHED

Maricopa County, Arizona

L A N D U S E A N D T R E A T M E N T

H Y D R O L O G I C I N V E S T I G A T I O N S

G E O L O G I C I N V E S T I G A T I O N S

S E D I M E N T A T I O N I N V E S T I G A T I O N S

E N G I N E E R I N G I N V E S T I G A T I O N S

E C O N O M I C I N V E S T I G A T I O N S

F I S H A N D W I L D L I F E I N V E S T I G A T I O N S

January 1971

LAND USE AND TREATMENT

Approximately 80 percent of the needed land treatment measures have already been applied. Due to the amount of treatment already applied and the rapid urban expansion, the only land treatment measures recommended are those to be installed on or near the structural measures for environmental purposes.

The cost of technical assistance for the follow-up and maintenance of the applied treatment measures will be borne by the going program of the Soil Conservation District.

The costs for landscaping and beautification were based on estimates furnished by the Office of the Landscape Architect, Arizona Highway Department. The Flood Control District of Maricopa County will bear the cost for installation and maintenance of these measures.

HYDROLOGIC INVESTIGATIONS

BASIC DATA

There are no U.S. Weather Bureau stations or USGS stream gaging stations located in the watershed. Precipitation amounts for the design of structures and the evaluation of damages were taken from U.S. Weather Bureau TP-40 revised maps dated 1967. The ratio of the 1 to 10 day precipitation was computed using U.S. Weather Bureau TP-149 values. This ratio was used to extend the design storm amounts from 1 to 10 days at the 100 year frequency of occurrence.

Soil and cover reconnaissance surveys were made of the watershed and curve numbers were assigned using procedures described in Chapters 7, 8 and 9 of Part 1, Section 4, NATIONAL ENGINEERING HANDBOOK (NEH).

Cross sections were surveyed at numerous locations and velocities were computed to determine the time of concentration of the upper portion of the watershed.

ALLUVIAL FAN FLOODING

The Town of Guadalupe is located on an alluvial fan. Interstate Highway I-10 traverses across the fan just above the town. The highway is located about three-fourths of a mile from the mouth of the Pima Canyon where water leaves the confined channel. By the very nature of the way fans are built, it is not possible to predict the exact paths of any given flow. Much research has been done on the geologic formulation of fans but the hydraulics of fan flooding are not easily evaluated.

Observation of fan flooding paths of flow, areas inundated and depths of flow have been made in many watersheds in Arizona. Analysis of existing data on fan flooding in other watersheds indicated a need for development of a consistent procedure to evaluate damages on fan areas. There was no historic data at the time of the planning of investigation in the Guadalupe Watershed.

The recent construction of the I-10 Highway altered the paths of any flooding that occurred in past years so that flooding that will occur in the future will be different from what it has been in the past. The I-10 Highway provides for drainage from water running off of the upper portion of the watershed; however, there are no confined channels below the outlets of the culverts so when water leaves the end of the culvert it will again spread out to a fan flood condition.

During the investigation period, a significant storm occurred on September 14, 1969, and a similar storm occurred on the 16th of September. Data was collected on the areas inundated and depths of flooding and peak discharges were estimated at locations where concentration of water occurred. The storm was unusual in that it did not cover the upper portion of the watershed. Precipitation was recorded about one mile away at the University of Arizona Experimental Station indicating an intensity of about three and one-half inches during the first hour of the storm. Analyses of records in this area show this to be about the one percent chance of occurrence for this high intensity storm. However, since the storm covered only the lower portion of the watershed, the damages that resulted from this storm were less than what would be expected from a one percent storm covering the whole watershed. Since the watershed is quite small, it is expected that this type of high intensity storm could cover the entire watershed. The damages that resulted from this storm are about the same magnitude as what would be expected from a one percent storm occurring on the watershed after construction of the project.

Observation of areas flooded by this storm indicated large areas being flooded to very low depths. Since there are no channels in the lower portion of the watershed, water runs off across lawns and down streets following the natural slope of the fan but small dikes, fences, driveways and walls can alter the direction of flow very easily and the areas flooded in one storm will not necessarily be flooded during the next storm. Since no channels exist at all any runoff that occurs will produce some damage.

Guadalupe Watershed fans are further complicated by the location of the I-10 Highway, the Highline Canal and the Western Canal. These improvements are all raised from one to five feet above the natural ground and traverse the fan approximately on a contour. I-10 is the only one of the improvements that provides for any

drainage on flood flows through culverts. However, this serves to concentrate flows in one location increasing the depth immediately downstream from these culverts. Since no channels continue below the culverts, water will immediately spread out again to lower depths in wide areas. The two canals have the opposite effect. They cause ponding of water on the upstream slope and depths are again increased. Overtopping of the canals causes breaks in the lining of the canals and the canals are filled with sediment. Often water remains in the ponding areas on the upstream side of the canals until it evaporates.

After studying the two floods, the conclusion was drawn to construct a procedure to evaluate flooding areas in a general way, and not tie this to a specific location. A computer program was developed to process large numbers of small discharges that do not concentrate into large channels. Widths of flooding were computed on the basis of discharge head above the available height of channel bank and then the areas flooded depend on the length of the fan reach involved in the particular analysis section or zone. Depths of flooding were distributed on a triangular relationship with the maximum depth occurring at the channel bank and decreasing linearly to zero at the maximum width of flooding. The watershed area subject to flooding was divided up into seven zones and discharges for one percent, ten percent and fifty percent events were computed. Areas inundated in each zone were computed for each frequency and depths were divided into four average depths covering 25 percent of the width of flooding in each zone. This variation of depth enabled the economist to compute damages on an increasing amount as the depth of flow increased. The program was then expanded to store the areas inundated at related depths, and to compute the damageable values based on the depth of flooding. These damageable values were then converted to total damages for each zone on the basis of the area inundated. The total damages were then accumulated for each frequency of occurrence. Damage reductions that will be realized by the construction of the project were then computed on the basis of reduced peak discharges that result in cutting off of flows from the upper portion of the watershed.

It must be recognized that this procedure computed the areas inundated in a general way only and does not relate to the specific topographic features in each zone. The order of magnitude of areas inundated computed with this procedure check

with historical data observed in the 1969 storms. Changes in man-made improvements on the fan will change the direction of flow and affect the specific locations of areas inundated, but will not significantly change the total areas of depths of inundation.

GEOLOGIC INVESTIGATIONS

GUADALUPE FLOODWATER RETARDING STRUCTURE AND SADDLE DIKE

Preliminary geologic investigations were conducted at the structural sites to determine the feasibility of the sites and to obtain basic data for design criteria. Inspection of rock outcrops, logs of test pits, and test results of the soil samples taken at the site were used to make the feasibility determinations. A total of 11 test pits were dug along the centerline of the two structures. Three soil samples were taken at the site for testing.

The foundation materials consist of coarse, gravelly, cobbly sand, and sandy silt. The soils are loose at the surface and generally become more compact with depth. Both abutments of the center section of the FRS and the saddle dike section and the left abutment of the I-10 section are composed of granite gneiss and schist.

The foundation material near the right end of the FRS may be subject to collapse upon saturation and loading. These low density, collapsible materials are found at a depth of about four feet.

Borrow materials were considered similar to those found along the centerline. The predominant material available for borrow is the silty sand.

One hole was dug along the centerline of the drainage channel that is located between the saddle dike and the center section of the FRS. The purpose of the drainage channel is to prevent any localized ponding of water in the vicinity of the saddle dike.

The materials found were silt and silty sand. One disturbed soil sample was taken from this hole.

The emergency spillway will be cut through the granite saddle between the saddle dike and the center section of the Guadalupe FRS.

GUADALUPE DIVERSION

The diversion was investigated in close proximity to the proposed centerline. Six test pits, ranging from five to nine feet, were dug. Three disturbed soil samples were obtained for testing.

The materials encountered were silty sand, silty, sandy gravel, and sandy silt. The materials generally become compact with depth.

The materials excavated from the low-flow channel can be used as fill material.

A stability analysis of the materials encountered in the test pits was made using the allowable velocity method of evaluation. The channel will be stable at the 10 percent event and some scour can be expected between stations 17+10 to 30+00 during the one percent event.

SEDIMENTATION INVESTIGATION

A sedimentation investigation was conducted on Guadalupe Watershed to determine the sediment yield to the proposed Guadalupe floodwater retarding structure, FRS.

A reconnaissance was made of the watershed to determine its characteristics and to locate stock ponds for reservoir sediment surveys. The watershed has a narrow elongated shape with relatively steep valley walls in the upper reaches. Many granite gneiss and schist outcrops are found throughout its length. (Bare rock makes up about 15 percent of the watershed above the FRS.) The surficial watershed material consists of medium to coarse, sandy, silty gravel and silty sand. The vegetative cover density is approximately two percent.

Since no suitable stock ponds were found, sediment information was obtained from the Harquahala Valley Watershed. Sediment rate information from the Big Horn Mountain Tank #2 was modified by adjusting the average annual rainfall. The adjusted on-site erosion rate was used to determine the sediment yield to the proposed Guadalupe FRS.

The delivery rate was obtained from the delivery rate curve of the Texas-Oklahoma and Eastern Sections and modified because of the shape and slope of the watershed.

The bedload sediment inflow was estimated and added to the sediment yield.

The sediment coming into the Guadalupe structure will consist of a substantial amount of coarse material.

There is a gravel pit in Pima Wash located about 800 feet upstream from the maximum waterline for the FRS. If this pit is left open, an estimated 2 acre feet of sediment will be deposited in it. The fine sediment, along with the remaining coarse sediment will be deposited in the FRS.

The trap efficiency of the structure was estimated by using the "capacity-inflow ratio curve". The trap efficiency is estimated to be 95 percent.

The estimated average annual sediment storage requirement for the Guadalupe FRS is .25 acre feet or about .13 acre feet per square mile of drainage area. The 100-year sediment storage requirement is 25 acre feet.

ENGINEERING INVESTIGATIONS

MAPS AND AERIAL PHOTOGRAPHS

Photogrammetric topographic maps with a scale of 1 inch = 200 feet with 2-foot contours and planimetric maps with a scale of 1 inch = 400 feet prepared in 1965 for the City of Tempe were utilized as base maps for planning activities. City of Tempe utility location maps and the as-built construction plans for Interstate Highway 10 were used to locate underground utilities and horizontal and vertical control survey monuments. An aerial mosaic was prepared from January 1970 flight.

SURVEYS

Centerline profiles of the floodwater retarding structure, diversion channel and diversion embankment were surveyed and used as a basis of computing volumes of embankment and earth excavation. Cross sections were surveyed for the emergency spillway to compute volumes of rock excavation. The length of the outlet pipeline was determined by a chained survey. Profile elevations for the outlet pipeline were taken from existing photogrammetric topographic maps. For land rights purposes a closed traverse survey with section line ties was surveyed for the floodwater retarding structure and diversion areas.

DESIGN CRITERIA

Guadalupe Floodwater Retarding Structure - The basic factors which had primary consideration in the design of the structure were to provide a 100-year level of protection with a limitation of 33 cubic feet per second maximum inflow from the structure into the Western Canal, and to insure that the routed freeboard hydrograph would not impinge upon the cemetery which is located upstream from the structure.

In order to minimize nuisance flows and sediment deposition into the Western Canal, the crest of the single stage principal spillway was set at the elevation of the 100-year sediment accumulation. The principal spillway riser is gated to allow drainage of the sediment pool. The principal spillway-outlet

pipeline system was designed to restrict the discharge from the structure to 23 cubic feet per second. The flood volume from the 100-year storm will be released in about five days without the use of the emergency spillway. The emergency spillway was designed using Soil Conservation Service standards for floodwater retarding structure in a hazardous situation, Class "C", in accordance with SCS National Engineering Memorandum 27.

The earth embankment design was based on a study of foundation and fill material. The nature and characteristics of these materials were determined by preliminary subsurface investigations and laboratory test results of soil samples.

After a storm, the sediment pool may contain water for several days before the gate is opened and the sediment pool is drained. Therefore riprap protection is provided on the upstream face of the floodwater retarding structure from natural ground up to elevation 1261.1, or 2.4 feet above the elevation of the 100-year sediment pool. The design thickness for the riprap was based upon criteria contained in "Engineering For Dams", Volume II, Justin, Creager, Hinds.

Guadalupe Diversion - The Guadalupe Diversion is designed to intercept the flows from the alluvial fan area and convey these flows to the Guadalupe FRS. The diversion is designed to provide protection from the 100-year storm.

The diversion consists of an excavated channel and earth fill embankment, with a pipe arch tunnel liner conduit installed underneath the west abutment of Interstate Highway 10 Guadalupe Road overpass.

That portion of the diversion located south of Guadalupe Road is designed to convey floodwaters without excessive erosion. Backwater conditions will exist in this portion of the diversion due to the Guadalupe Road conduit. Additional embankment height was added to allow for deposition of sediment. The diversion has been designed to accommodate a 100-year accumulation of sediment and still safely convey a 100-year peak discharge of 120 cubic feet per second without overtopping the embankment. If excessive sedimentation occurs, removal of these sediments is recommended. The design of the embankment for this portion of the diversion

was based on criteria for a Class I Dike in SCS National Engineering Handbook, Section 2.

The hydraulic design of the Guadalupe Road pipe arch tunnel liner conduit was based on procedures from U.S. Bureau of Public Roads Hydraulic Engineering Circulars Nos. 3 and 10. The conduit is designed to convey floodwaters without sediment deposition.

The portion of the diversion located north of Guadalupe Road is designed to convey floodwater without excessive erosion or deposition of sediment. The embankment for this portion of the diversion is an extension of the floodwater retarding structure embankment.

The channel designs were based on a study of erosion resistant characteristics of channel materials. The embankment design was based on a study of foundation and fill material. The nature and characteristics of these materials were determined by preliminary subsurface investigations and laboratory test results of soil samples.

The channel portions of the diversion has been stabilized by rock riprap at the entrance and outlet of the Guadalupe Road conduit. The thickness and size of the rock riprap to be used was based on Section V "Criteria for Rock Riprap Size" in SCS Engineering Design Standards, Far West States.

Outlet Pipeline - The design of the outlet pipeline was based on a maximum release rate of 23 cubic feet per second from the Guadalupe Floodwater Retarding Structure. This 21 inch diameter concrete pipeline will be operating under pressure flow conditions throughout its length. SCS Computer Program FW-HY2-1130F Principal Spillway Routing was utilized for a hydraulic design of the pipeline with a simultaneous flood routing of the principal spillway hydrograph.

A L T E R N A T E S T U D I E S

An alternate location for the Guadalupe Floodwater Retarding Structure placed the structure on South Mountain Park land approximately 3600 ft. upstream from the present location. This site was eliminated because of the small drainage area that it would control.

An alternate study was made of extending the diversion further to the south to provide protection for the unimproved land located immediately south of the community of Guadalupe. The natural ground at the location of this proposed extension slopes to the south, or directly opposite to the required direction of flow in the diversion. Because of the "back cut" required, this proposal was not physically feasible.

An alternate location for the outlet pipeline placed the outlet pipeline on the right-of-way for Interstate Highway 10 from Beverly Road to the Western Canal. This alternate was eliminated because the Interstate Highway System does not have provisions for right-of-entry within the highway right-of-way.

An alternate study was made of installing the Guadalupe Road conduit by "jacking" methods. After consultations with local contractors who specialize in this type of work, this alternate was rejected as not being physically feasible.

An alternate study was made of using an orifice plate to control the discharge from the FRS in lieu of pressure flow in the outlet pipeline. To maintain the discharge at less than 33 cfs, this would require a 9 inch orifice opening for a 30 inch barrel through the FRS. Because of plugging problems associated with the relatively small 9 inch orifice opening, this alternate was rejected.

C O S T E S T I M A T E S

Land Treatment Measures - The costs for landscaping and beautification were based on estimates furnished by the Office of the Landscape Architect, Arizona Highway Department.

Structural Measures - The cost of construction items for the floodwater retarding structures and diversion were based primarily on costs of previous PL-566 contracts for flood prevention projects in Arizona. Estimates for unit costs of the outlet pipeline were based on contract costs for the installation of identical type and size of pipe by the U.S. Bureau of Reclamation. Costs for constructing the Guadalupe road tunnel liner conduit were based on estimates furnished by a local contractor who specializes in this type of installation and from the City of Phoenix, Sewage Division.

Engineering Services - Engineering service costs were derived by the use of Soil Conservation Service criteria. Total engineering service costs are estimated to be twenty percent of the construction costs.

Project Administration - The local project administration cost is estimated to be one percent of the total construction costs. State dam filing fees are an additional administration cost and were computed in accordance with Arizona Highway Department publication "Code Governing Supervision and Control of Dams Revised 1951." The PL-566 project administration cost is estimated to be 10 percent of the total construction costs.

Operation and Maintenance Costs - Estimates for operation and maintenance were computed using percentages of construction costs within the ranges given in Watershed Memorandum - California No. 6.

NOTE: For purposes of computing the costs of engineering services, project administration, and operation and maintenance, the construction cost used is the sum of the PL-566 construction costs for structural measures ($246,360) plus the estimated cost for the Guadalupe Road conduit, a land rights item ($30,460).

Utility Modification Costs - Costs for relocating the two 10-3/4 inch El Paso Natural Gas lines and for lowering American Telephone and Telegraph telephone cable were based on estimates furnished by El Paso Natural Gas Company and American Telephone and Telegraph Company. Costs for other utility modifications and inspection costs are based on actual costs for similar type works.

Rights-of-Way Costs - Rights-of-way costs were estimated by the Rights-of-Way Section, Arizona Highway Department, based on recent sales of similar properties associated with the construction of Interstate Highway 10. Costs associated with acquiring the lands for right-of-way were computed on a per parcel basis. The actual land value costs were increased by twenty percent for all administrative costs associated with acquiring the lands. The twenty percent factor was estimated by the Arizona Highway Department based on costs experienced by the department in acquiring lands for other projects.

ECONOMIC INVESTIGATION

Separate evaluation units were considered for the community of Guadalupe and for the remaining floodplain area. Consideration was given to land use, structural values, rate and type of growth expected.

The need for two evaluation units was largely due to the extensive poverty condition within the community of Guadalupe. Average unit values of homes range from about $1,500 and $4,800 within the community of Guadalupe to about $18,000 and $25,000 in the remaining floodplain area.

A sample of forty owners or occupants representing eight hundred and fifty-six homes within the community of Guadalupe were interviewed directly following the September 14 and 16, 1969 floods. The local Guadalupe Organization, Incorporated furnished the translators needed to complete much of the economic field work and physical surveys since the ethnic composite of this evaluation unit was about fifty-five percent Mexican-American, forty-four percent Yaqui Indian and one percent Negro and Anglo.

It was estimated that floodwater entered 137 homes and 670 yards within the community of Guadalupe during each of the September 1969 flood events. Flood flows, depths of inundation, value of dwellings and other pertinent depth-damage relationships were established for the above flood events.

Residential flood damages outside the community of Guadalupe were also established on a sample basis.

Commercial flood damages were obtained by contacting fifty percent of business establishments.

County officials reported 1969 flood damages to roads and streets.

The Southern Pacific Transportation Company reported 1969 flood damages. Other industrial damages were based on field surveys.

Agricultural flood damages were determined from interviews with farmers following the September 14, 1969 flood event. Crop and pasture damages by months were based on these interviews and data from other PL-566 watershed evaluations in Maricopa County.

Irrigation canal damages were based on information supplied by the Salt River Water Users' Association for the 1965 and 1969 flood events.

The GENERAL PLAN - TEMPE, ARIZONA was the basis for urban projection used in determining growth. Projected development was considered in place for the formulation of the without project condition. Residential damages were adjusted to reflect increases in future damageable values including future time of development. The estimated projected urban damages are considered conservative. Future urban development above the West Branch of the Highline Canal and the commercial or industrial growth below this canal were not considered for project evaluation.

Methods and techniques used in arriving at the average annual damages were based on the damage-frequency procedure as outlined in the Economic Guide for Watershed Protection and Flood Prevention. Computer programs were developed to evaluate average annual damages to crop and pasture and existing and future projected residential properties.

Indirect damages from ten to fifteen percent were based on empirical data. The indirect damage reduction benefits shown on Table 5 are 10.05 percent of the direct damages.

Depressed market values due to partially repaired flood damages on neighboring properties were not evaluated.

The adverse social effects on the lives of people were apparent but not monetarily considered. In areas like Guadalupe where many families live on limited incomes, recovery from natural disasters such as floods require long periods of time as material gains are few and often obtained with much sacrifice.

Secondary benefits were not considered in project evaluations.

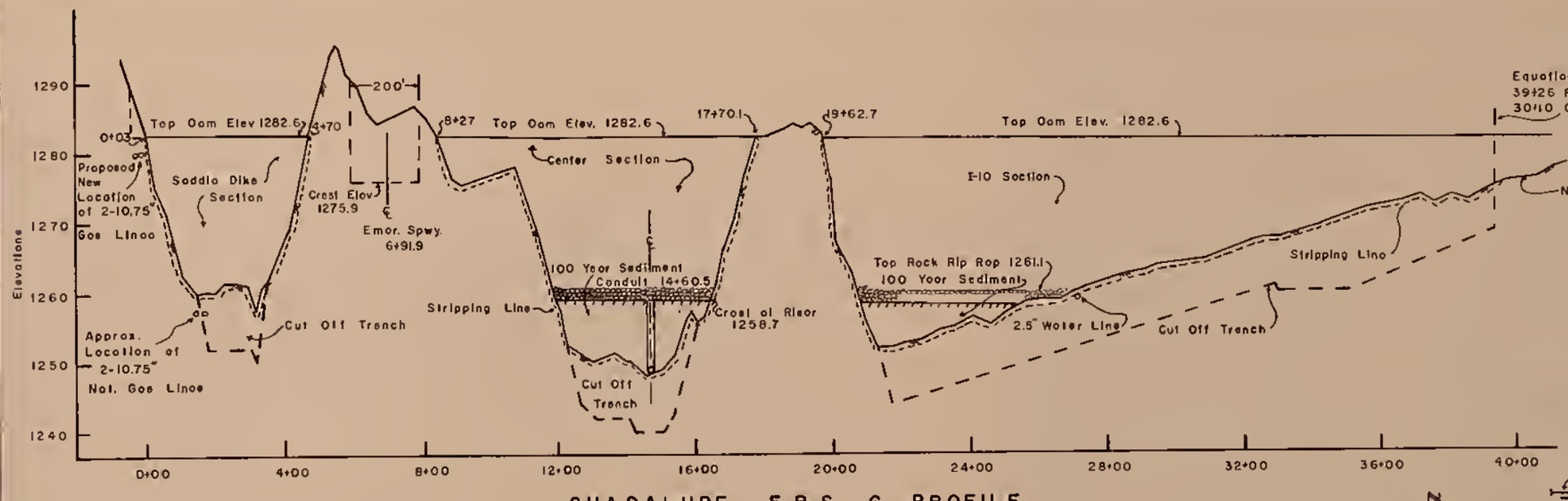
Proposed environmental land treatment was not considered to have a measurable reduction on flood damages.

Benefits and operation and maintenance costs are on a normalized price base while 1970 installation costs were amortized at the interest rate of 5-1/8 percent prior to comparison.

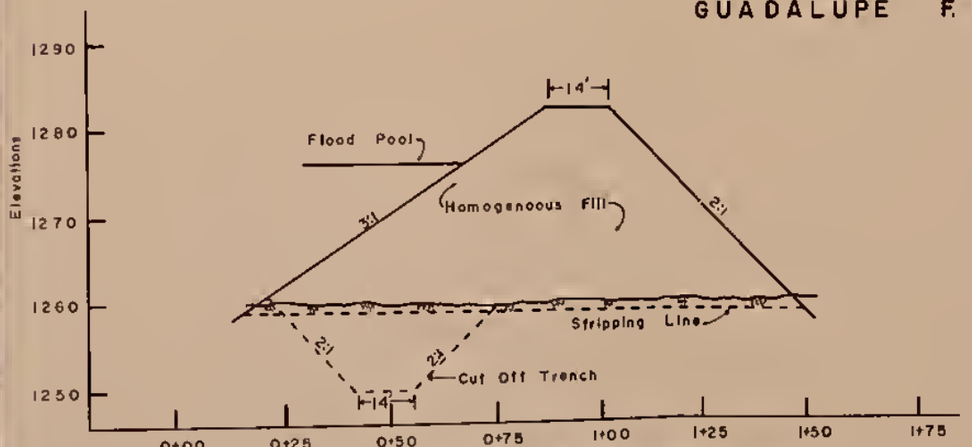
FISH AND WILDLIFE INVESTIGATIONS

Fish and wildlife investigations were conducted by the Bureau of Sport Fisheries and Wildlife of the United States Department of the Interior in cooperation with the Arizona Game and Fish Department. A letter from the Bureau of Sport Fisheries and Wildlife dated April 3, 1969, states, "We have concluded that the project would not significantly affect fish and wildlife resources of the watershed. Further, the project would offer no feasible opportunities for improvement of fish and wildlife."

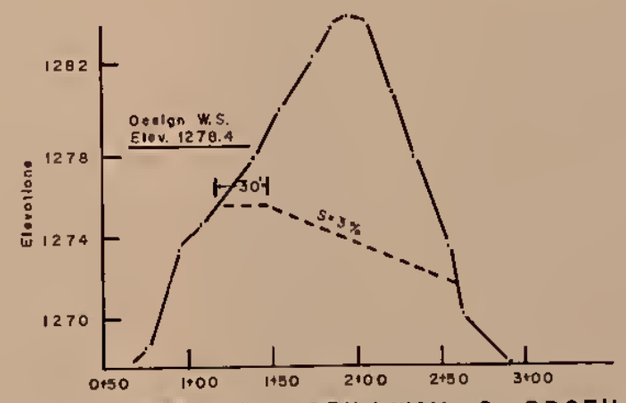
Copies of the complete Fish and Wildlife report may be obtained from the Bureau of Sport Fisheries and Wildlife office at Albuquerque, New Mexico.



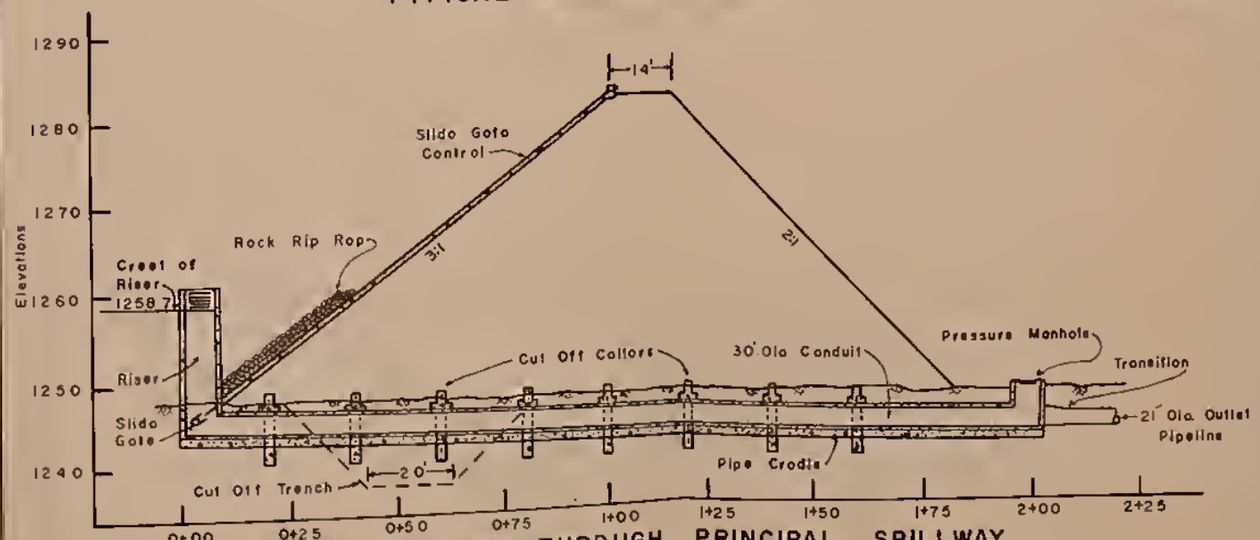
GUADALUPE F. R. S. ℄ PROFILE



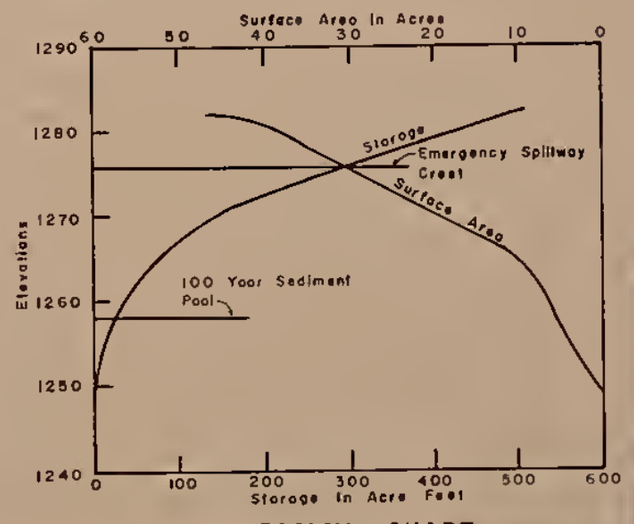
TYPICAL CROSS SECTION



EMERGENCY SPILLWAY ℄ PROFILE

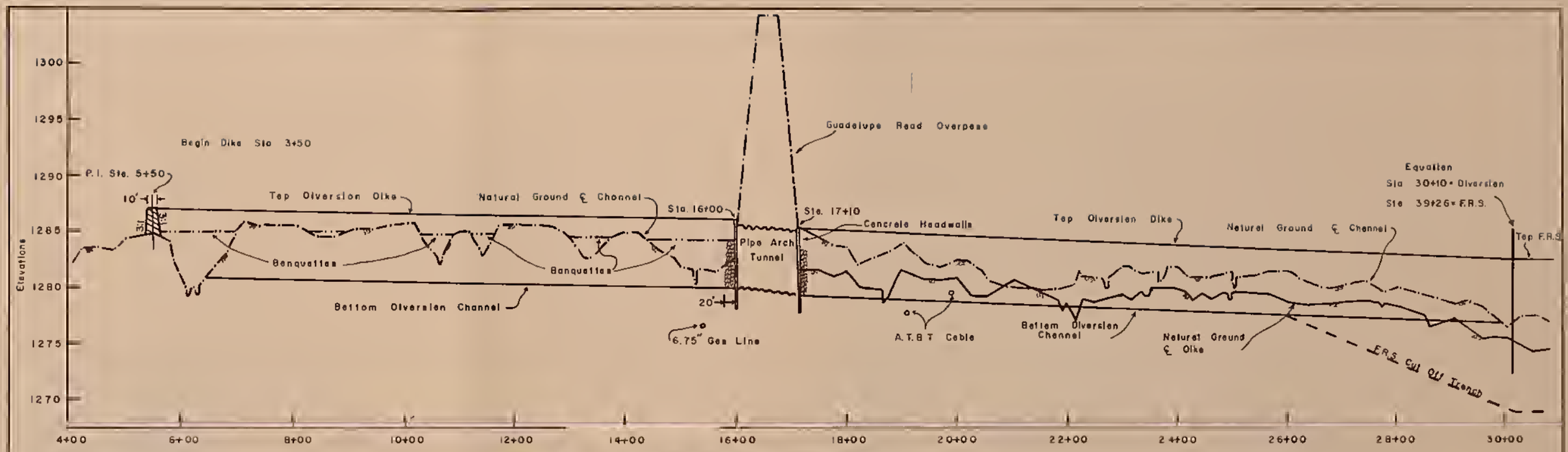


CROSS SECTION THROUGH PRINCIPAL SPILLWAY @ STATION 14+60.5

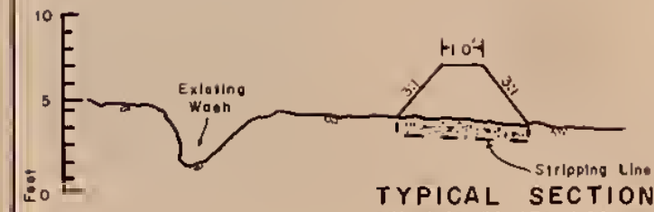


CAPACITY CHART

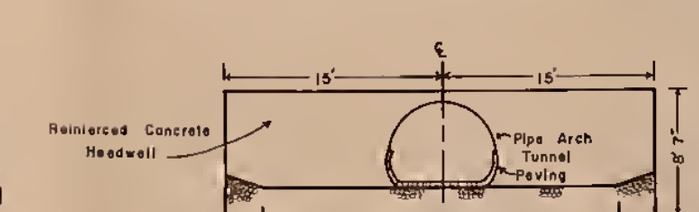
FIGURE I-A WORK PLAN
FLOODWATER RETARDING STRUCTURE
GUADALUPE WATERSHED
MARICOPA COUNTY, ARIZ
[illegible] PLANS
U.S. DEPARTMENT OF AGRICULTURE,
SOIL CONSERVATION SERVICE
PREPARED BY J.W. DATE 1-18-71 SHEET 1 OF 2



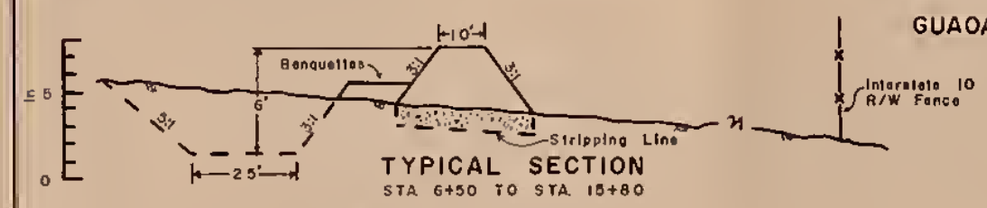
PROFILE OF GUADALUPE DIVERSION



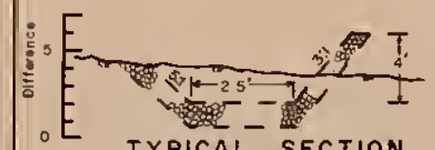
TYPICAL SECTION
STA. 3+50 TO STA. 6+50



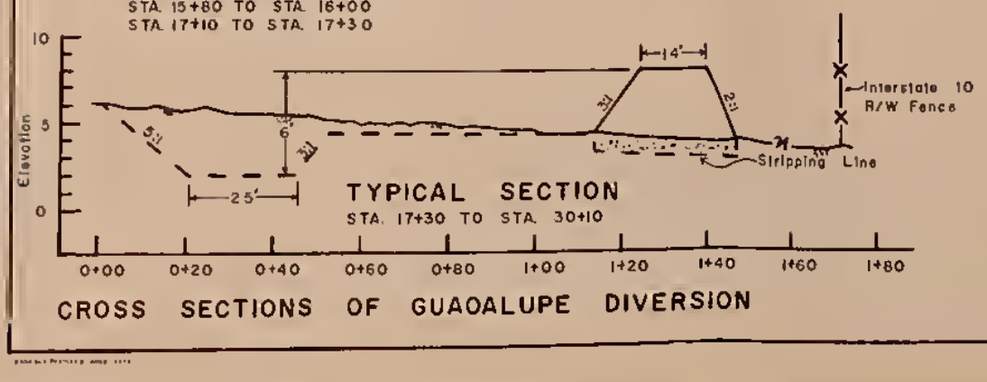
SECTION
GUADALUPE ROAD CONDUIT



TYPICAL SECTION
STA. 6+50 TO STA. 15+80



TYPICAL SECTION
STA. 15+80 TO STA. 16+00
STA. 17+10 TO STA. 17+30



TYPICAL SECTION
STA. 17+30 TO STA. 30+10

CROSS SECTIONS OF GUADALUPE DIVERSION

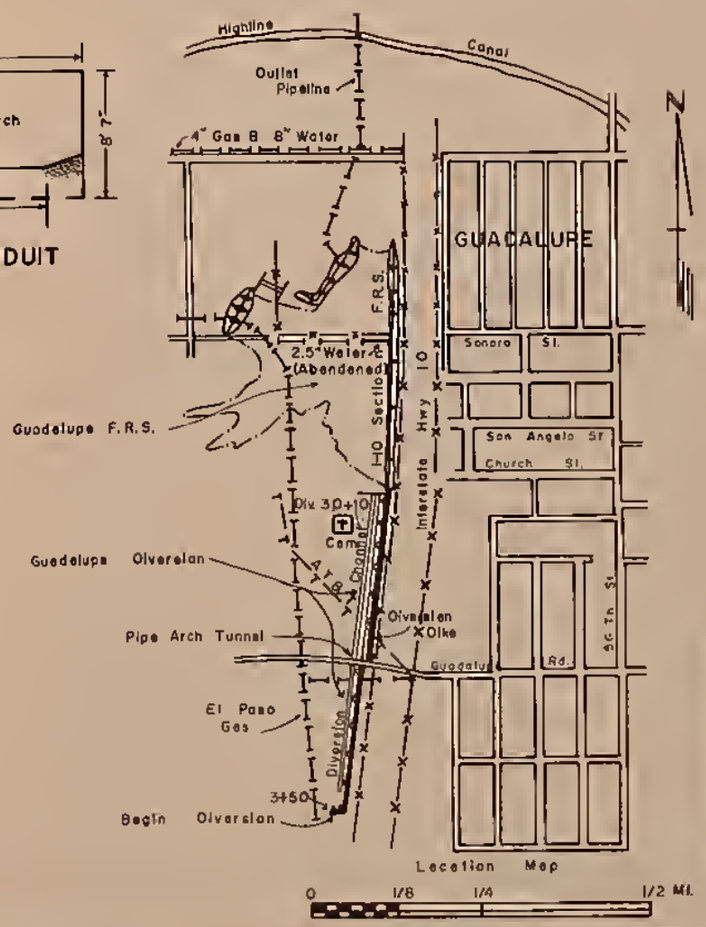


FIGURE 1-8 WORK PLAN
GUADALUPE DIVERSION
GUADALUPE WATERSHED
MARICOPA COUNTY, ARIZ
PRELIMINARY PLANS
U.S. DEPARTMENT OF AGRICULTURE,
SOIL CONSERVATION SERVICE
PREPARED BY J.W. DATE 1-18-71 SHEET 2 OF 2

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

LEGEND

- Drainage area controlled
- Area benefited
- Floodwater retarding structure (F.R.S)
- Diversion
- Outlet pipeline
- City limits

CITY OF PHOENIX

T. 1 N.
T. 1 S.

R. 4 W.

32

33 CITY OF TEMPE

BASELINE ROAD

BEVERLY ROAD

OUTLET PIPELINE

1-10 SECTION F.R.S.

CENTER SECTION F.R.S.

SADDLE DIKE

GUADALUPE F.R.S.

5

4

GUADALUPE

PHOENIX SOUTH MOUNTAIN PARK

D.A. 107 SQ. MI

GUADALUPE DIVERSION

8

9

GUADALUPE ROAD

CANAL

KYRENE

ELLIOT ROAD

MARICOPA COUNTY

Guadalupe Watershed

LOCATION MAP

FIGURE 2

PROJECT MAP

GUADALUPE WATERSHED

MARICOPA COUNTY, ARIZONA

JANUARY 1971

1/4 0 1/4 1/2 3/4 1 MILE

SCALE 1 24,000